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The inversion of (3) was so chosen that the original sphere became a plane, thus making the solution depend upon the simpler problem of finding the orthogonal trajectory of a family of plane curves.

Also solved by G. B. M. Zerr.

CALCULUS.

81. Proposed by J. OWEN MAHONEY, M. Sc., Dallas, Texas.

$$\text{Solve, } y^2 \frac{d^2y}{dx^2} + a \frac{dy}{dx} = bx.$$

Solution by G. B. M. ZERR, A. M., Ph. D., Persons, W. Va.

$$\text{Let } y = A + Bx + Cx^2 + Dx^3 + Ex^4 + \dots$$

$$\frac{dy}{dx} = B + 2Cx + 3Dx^2 + 4Ex^3 + 5Fx^4 + \dots$$

$$\frac{d^2y}{dx^2} = 2C + 6Dx + 12Ex^2 + 20Fx^3 + 30Gx^4 + \dots$$

$$y^2 = A^2 + B^2x^2 + C^2x^4 + 2ABx + 2ACx^2 + 2ADx^3 + 2AEx^4 + 2BCx^3$$

$$+ 2BDx^4 + \dots$$

$$\therefore y^2 (d^2y/dx^2) + a(dy/dx)^2 = bx \text{ gives us}$$

$$\begin{array}{l|llllll} bx = 2A^2C & +6A^2D & | x + 12A^2E & | x^2 + 20A^2F & | x^3 + 30A^2G & | x^4 + \dots \\ +aB^2 & +4ABC & | + 2B^2C & | + 6B^2D & | + 12B^2E & \\ +4aBC & +12ABD & | + 24ABE & | + 2C^3 & \\ +4AC^2 & +4AC^2 & | + 16ACD & | + 40ABF & \\ +4aC^2 & +6aBD & | + 4BC^2 & | + 28ACE & \\ +6aBD & & | + 8aBE & | + 12AD^2 & \\ & & | + 12aCD & | + 16BCD & \\ & & & | + 9aD^2 & \\ & & & | + 10aBF & \\ & & & | + 16aCE & \end{array}$$

Equating like powers of x we get

$$C = -\frac{aB^2}{2A^2}, \quad D = \frac{2A^2b + 4aAB^3 + 4a^2B^3}{12A^4},$$

$$E = \frac{aB^4[A^2 - (A+a)(4A+3a)] - abA^2B - 2bA^3B}{12A^6}.$$

$$\therefore y = A + Bx - \frac{aB^2}{2A^2}x^2 + \frac{2A^2b + 4aAB^3 + 4a^2B^3}{12A^4}x^3$$

$$+ \frac{aB^4[A^2 - (A+a)(4A+3a) - abA^2B - 2bA^3B]}{12A^6}x^4 + \dots$$

where A and B are constants of integration.

This solution does not give a unique result.